Instructional Overview for Use of the Digitrip OPTIM Communicating Trip Unit System

PROTECTION AND COORDINATION

POWER QUALITY

ENERGY MONITORING

COMMUNICATIONS SYSTEMS

Effective 11/98 Supersedes I.B. 29C890 dated May 1996

EATON

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1-1 COMMON TERMS

Several commonly used terms or phrases are used throughout this manual. They are defined here to eliminate any confusion that might arise when reading the text.

IMPACC (Integrated Monitoring, Protection and Control Communications) – A family of communicating electrical power distribution protective devices, meters, motor control devices, communications networks and protocols and software packages to provide power distribution monitoring and control.

INCOM (Industrial Communications) – A noise immune communications system designed specifically for power distribution monitoring and control applications.

PONI (Product Operated Network Interface) – A plug-in communications module that enables network communications.

1-2 PRELIMINARY COMMENTS AND SAFETY PRECAUTIONS

This instructional manual is intended to present an overview of the comprehensive Digitrip OPTIM Trip Unit System. In addition, specific application possibilities and techniques are covered in Section 3 of this manual. Each device which is or could be included in any coordinated protection/monitoring system is discussed.

Notice: *Detailed instructional material relative to the installation, use and maintenance of specific devices is included under separate cover by a manual dedicated to each device. A series of four manuals brings together the wide array of capabilities offered by the most advanced programmable trip unit system - Digitrip OPTIM. Refer to Appendix A for specific instructional references.*

Please read and understand this manual and all other relevant manuals before proceeding with the installation and operation of any device included in the trip unit system. Pay particular attention to all WARNINGS and CAUTIONS. They are intended to help insure personnel safety and equipment protection. Refer to the WARNING and CAUTION in Paragraph 1-2.1 before proceeding to any other section in this manual or any other manual. If further information is required by the purchaser regarding a particular installation, application or maintenance activity, a Cutler-Hammer representative should be contacted.

1-2.1 SAFETY PRECAUTIONS

All safety codes, safety standards and/or regulations must be strictly observed in the installation, operation and maintenance of any device in this system.

WARNING

THE WARNINGS AND CAUTIONS INCLUDED AS PART OF THE PROCEDURAL STEPS IN THIS DOCUMENT ARE FOR PERSONNEL SAFETY AND PROTECTION OF EQUIPMENT FROM DAMAGE. AN EXAMPLE OF A TYPICAL WARNING LABEL HEADING IS SHOWN ABOVE IN REVERSE TYPE TO FAMILIARIZE PERSONNEL WITH THE STYLE OF PRESENTATION. THIS WILL HELP TO INSURE THAT PERSONNEL ARE ALERT TO WARNINGS, WHICH MAY APPEAR THROUGHOUT THE DOCUMENT. IN ADDITION, CAUTIONS ARE ALL UPPER CASE AND BOLDFACE AS SHOWN BELOW.

CAUTION

COMPLETELY READ AND UNDERSTAND THE MATERIAL PRESENTED IN THIS DOCUMENT BEFORE ATTEMPTING INSTALLATION, OPERATION OR APPLICATION OF THE EQUIPMENT. IN ADDITION, ONLY QUALIFIED PERSONS SHOULD BE PERMITTED TO PERFORM ANY WORK ASSOCIATED WITH THE EQUIPMENT. ANY WIRING INSTRUCTIONS PRESENTED IN THIS DOCUMENT MUST BE FOLLOWED PRECISELY. FAILURE TO DO SO COULD CAUSE PERMANENT EQUIPMENT DAMAGE.

SECTION 2: SYSTEM OVERVIEW

2-1 INTRODUCTION

The Digitrip OPTIM Trip Unit System is a programmable, communicating, microprocessor-based low voltage trip unit system. It is compatible with Series C̄ K-Frame, L-Frame, N-Frame and R-Frame Molded Case Circuit Breakers, SPB Systems Pow-R Circuit Breakers, and DSII/DSLII Power Circuit Breakers (Figures **2-1**, **2-2**, and **2-3**). These circuit breakers using the Digitrip OPTIM Trip Unit System cover a range of rated currents from 70 to 5000 amperes. The Digitrip OPTIM System has the capabilities to provide:

- Programmable protection and coordination
- Trip early warnings
- System diagnostics
- System monitoring
- Power quality monitoring
- Energy monitoring and management
- Communications

Digitrip OPTIM systems can be tailored to meet very precise system requirements. The featured parts of an OPTIM Trip Unit System are:

- RMS Sensing Trip Unit (OPTIM 550, 750 and 1050)
- Hand Held Programmer (OPTIMizer) (Figure **2-4**)
- Breaker Interface Module (Figure **2-5**)
- Communications System and Software (IMPACC) (Figure **2-6**)

A Digitrip OPTIM Trip Unit System always includes any number of Digitrip OPTIM Trip Units with one or more Hand Held Programmers (OPTIMizer). The system can also include a panel mount Breaker Interface Module and IMPACC Communications and software. Specific customer requirements dictate what devices will be used for any given system (Figure **2-7**).

Notice: *Keep in mind that an OPTIMizer Hand Held Programmer is required during initial start-up for all applications.*

Application of low voltage circuit breakers utilizing OPTIM Trip Units generally fall into three primary categories:

Stand Alone Application (Individual Circuit Breakers)

These applications are utilized to take advantage of the superior protection and coordination features of Digitrip

Figure 2-1 Series C̄ L-Frame Molded Case Circuit Breaker with OPTIM Trip Unit

Figure 2-2 SPB Systems Pow-R Breaker with OPTIM Trip Unit

Figure 2-3 DSII Power Circuit Breaker with OPTIM Trip Unit

Figure 2-4 Hand Held Programmer (OPTIMizer)

Figure 2-5 Breaker Interface Module

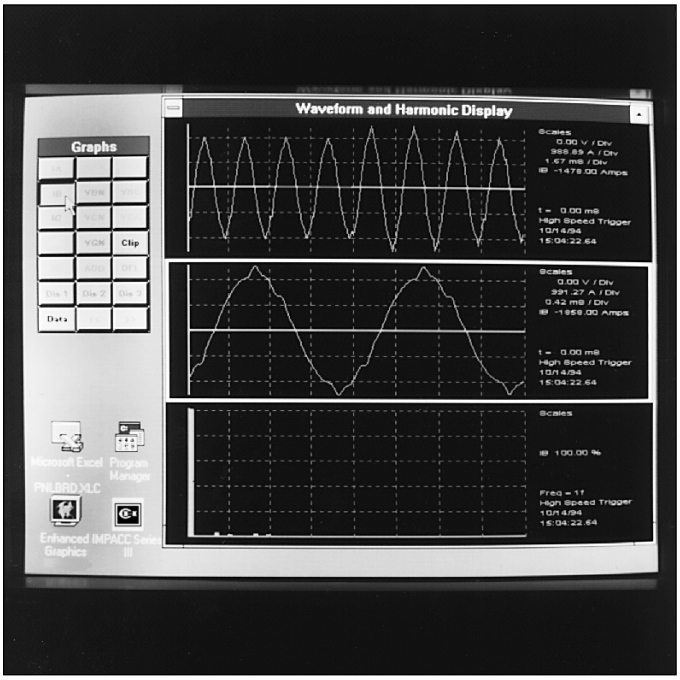

Figure 2-6 Typical Waveform and Harmonic Display

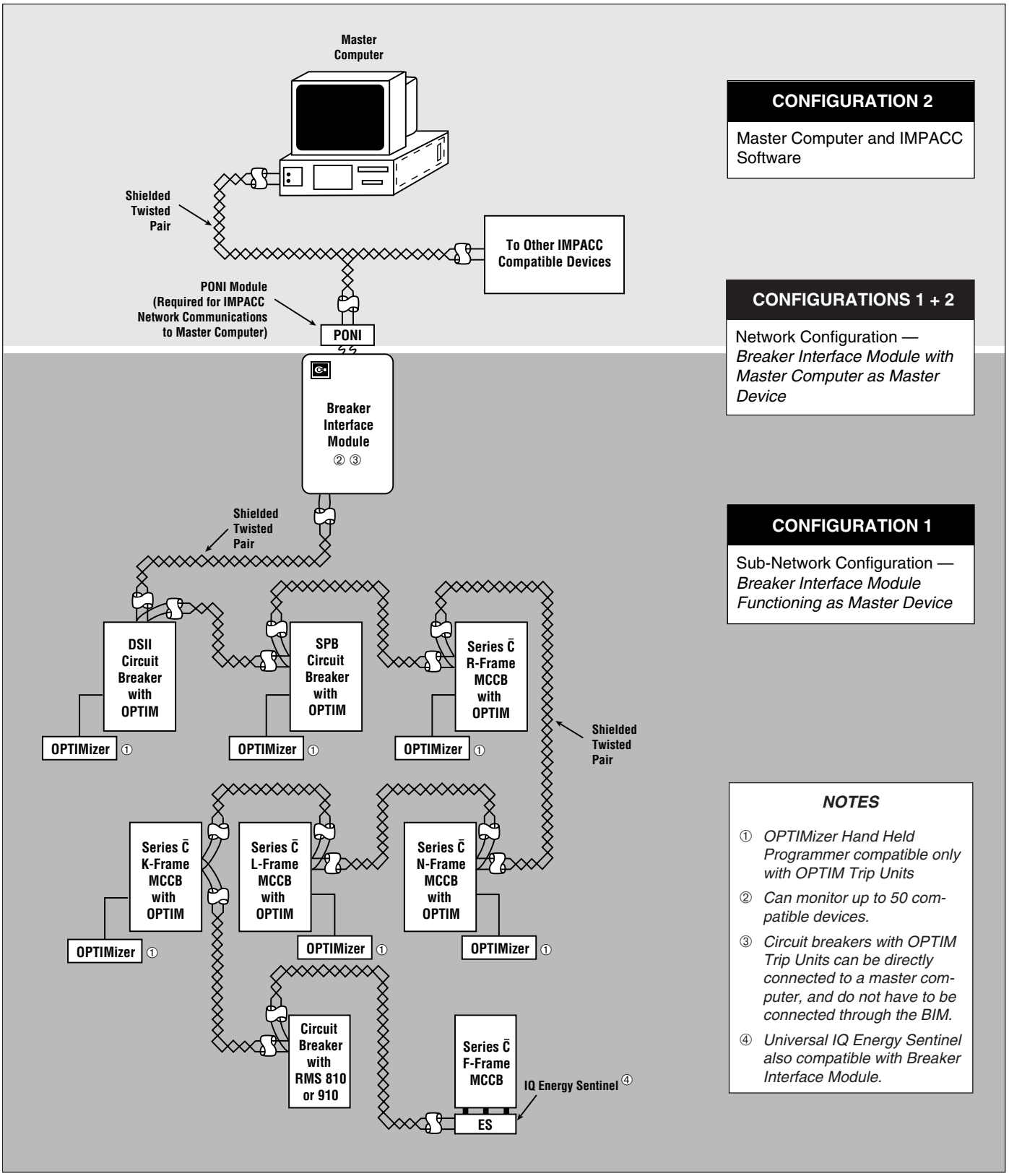

Figure 2-7 Typical System Configurations

OPTIM, and plan to perform monitoring at the circuit breaker itself (Figure **2-8**).

The following would be used:

- OPTIM 550, 750 and/or 1050 Trip Units
- One or more OPTIMizer Hand Held Programmers

Integrated Assembly Applications (Low Voltage Assemblies)

These applications are utilized to provide on-gear or remote monitoring and even testing of compatible devices (Figure **2-9**). Up to 50 OPTIM Trip Units, Digitrip RMS 810/910 Trip Units or IQ Energy Sentinels can communicate with one Breaker Interface Module.

The following would be used:

- OPTIM 550 (if field IMPACC kit is installed)
- OPTIM 750 and/or 1050 Trip Units
- Digitrip RMS 810 and/or 910 Trip Units
- IQ Energy Sentinels
- One or more OPTIMizer Hand Held Programmers
- One or more assembly/remotely mounted Breaker Interface Modules

Facility Wide Application (IMPACC System)

These applications are utilized to tie together more than 50 circuit breakers and/or other compatible devices. In addition, this permits taking advantage of PC-based software to improve diagnostics, power quality and energy monitoring, or protective device coordination capabilities. The system would consist of any number of devices and software products, either within a facility or across multiple facilities (Figure **2-10**).

The following would be used:

- OPTIM 550 (if field IMPACC kit is installed)
- OPTIM 750 and/or 1050 Trip Units
- Digitrip RMS 810 and/or 910 Trip Units
- Other IMPACC Compatible devices
- One or more OPTIMizer Hand Held Programmers
- One or more assembly/remotely mounted Breaker Interface Modules
- IMPACC software/central PC

For additional IMPACC details, refer to Section 3 of this manual.

2-2 TRIP UNITS

Digitrip OPTIM 550 and 750 Trip Units provide a wide range of common protection and coordination features and functions. The Digitrip OPTIM 1050 Trip Unit also provides power quality and energy monitoring capabilities (Figure **2-11**).

Figure 2-8 Hand Held Programmer in Use

Figure 2-9 Breaker Interface Module in Service

2-2.1 COMMON FEATURES OF DIGITRIP OPTIM 550, 750 AND 1050 TRIP UNITS

Precise system coordination is provided by an expansive number of time-current curve shaping adjustments. This is accomplished by the large number of incremental setpoints available for both current pickup and time settings.

Programmable Protection and Coordination Adjustments

- Long delay setting
- Long delay time with selectable I^2t or I^4t slopes
- Short delay setting
- Short delay time with selectable flat or I^2t slopes
- Instantaneous setting
- Ground fault setting (550 with ground, 750 and 1050)
- Ground fault time with selectable flat or I^2t slopes

The trip units also have a selectable powered/ unpowered thermal memory to provide protection against cumulative overheating should a number of overload conditions occur in quick succession.

The trip unit information system utilizes LEDs to indicate the trip mode following an automatic trip operation. The LEDs are complemented by trip event information that is stored in non-volatile memory after a trip condition. This trip information can then be accessed via the OPTIMizer

Figure 2-10 Monitor and Control from Central PC

Applicable Circuit Breaker Types and Trip Unit Type							
K, L, N & R	R, SPB & DSII	K thru DSII	R thru DSII	K thru DSII	R thru DSII	R thru DSII	K thru DSII
RMS 310	RMS 510	OPTIM 550 ①	RMS 610	OPTIM 750	RMS 810	RMS 910	OPTIM 1050
RMS Sensing	RMS Sensing	RMS Sensing	RMS Sensing	RMS Sensing	RMS Sensing	RMS Sensing	RMS Sensing
5 Functions	9 Functions	10 Functions	9 Functions	10 Functions	9 Functions	9 Functions	10 Functions
Front Adjustable	Front Adjustable	Programmable	Front Adjustable	Programmable	Front Adjustable	Front Adjustable	Programmable
			Load Monitoring	Load Monitoring	Load Monitoring	Load Monitoring	Load Monitoring
			Diagnostics	Diagnostics	Diagnostics	Diagnostics	Diagnostics
				Communications	Communications	Communications	Communications
					Power & Energy Monitoring	Power & Energy Monitoring	Power & Energy Monitoring
						Harmonics	Harmonics
		① Field Installed communications available					

Figure 2-11 Family of Digitrip Trip Units Comparison

Hand Held Programmer, the Breaker Interface Module, or over the IMPACC System.

Selectable early warning alarms, such as the high load current alarm, are capable of being indicated locally and remotely. They are provided to help keep a system operating and productive.

System Monitoring

All OPTIM Trip Units are capable of monitoring the following data:

- Steady-State value of phase and neutral current and ground currents with ground alarm or ground trip type trip units
- Minimum and maximum current values
- Average demand current
- Cause of trip
- Magnitude of fault current responsible for an automatic trip operation

Communications

Trip units are capable of two way communication via a network twisted pair for remote monitoring and control. The circuit breaker, through the trip unit, is able to respond to open and close commands via the communication network. To close the breaker, a motor operator accessory is required. Refer to Table **A.1** in Appendix A for motor operator instructional references.

Testing

An integral testing capability is part of all OPTIM Trip Units. The breaker can be tested in either the “Trip” or “No Trip” Test Mode. System level testing is carried out by using a Hand Held Programmer (Paragraph 2-3), a Breaker Interface Module (Paragraph 2-4), or a remote computer (Paragraph 2-6). Bench level testing requires the Hand Held Programmer only. Trip tests with the Hand Held Programmer requires an auxiliary power module to supply the necessary power. Trip units continue to provide protection during test operations.

Data Access

All programming, information display and general trip unit access is accomplished through the use of one or more of the following:

- Hand Held Programmer
- Breaker Interface Module
- Remote computer

2-2.2 ADDITIONAL FEATURES OF DIGITRIP OPTIM 1050 TRIP UNITS

The Digitrip OPTIM 1050 Trip Unit provides all the basic system protection features just outlined in Paragraph 2-2.1. In addition, Digitrip OPTIM 1050 Trip Units can provide data on power quality (current harmonics) and permit energy monitoring.

Energy Monitoring

- Peak demand (kW)
- Present demand (kW)
- Forward energy (kWh)
- Reverse energy (kWh)
- Total energy (kWh)
- Power factor

Power Quality

- Percentage harmonic content
- Total harmonic distortion (THD)

Notice: *For detailed information concerning the installation, operation and maintenance of Digitrip OPTIM Trip Units, refer to the instruction book prepared specifically for the trip units (I.B. 29C891).*

2-3 HAND HELD PROGRAMMER (OPTIMizer)

The OPTIMizer (Hand Held Programmer) is required for all OPTIM Trip Unit Systems. It plugs into the front of OPTIM 550, 750 or 1050 Trip Units and is powered by a standard nine volt battery (Figures **2-4** and **2-8**) or auxiliary power module. The OPTIMizer accesses, displays, and configures information from OPTIM Trip Units, and provides a broad range of programming and testing possibilities.

An OPTIMizer must be used to configure the trip unit for communications on the INCOM Network. This requires an operator, during initial start-up, to:

- **Assign Unique Device Addresses**
- **Select Baud Rates**

In addition, the OPTIMizer can be used to:

- **Configure OPTIM Trip Unit**
  - Select frequency (50/60 Hz)
  - Set security passwords
  - Change time-current setpoints
  - Select protection options
  - Select high load alarm level

- **Display Information**
  - Breaker description
  - Time-current setpoints
  - Metered values
  - Trip event information

- **Test OPTIM Trip Unit Performance**
  - Phase and ground
  - Trip or no trip

- **Communicate Over INCOM**

Integral to the hand held programmer is the ability to lock out changes to a breaker's settings through the use of a password. The correct password must be entered to proceed with settings changes. The password entry field contains four digits that can be changed. The factory installed password **1000** can be used until a new password is programmed by the user.

Notice: *For detailed information concerning the operation of the Hand Held Programmer (OPTIMizer), refer to the instruction book prepared specifically for the OPTIMizer (I.B. 29C892).*

2-4 BREAKER INTERFACE MODULE

The Breaker Interface Module is a comprehensive, multi-function, microprocessor-based operator interface that can be mounted locally at the device or at a remote location (Figures **2-5** and **2-9**). In conjunction with the OPTIM Trip Unit it accomplishes the functions of individually mounted devices, such as wired ammeters, ammeter switches, watthour meters, breaker indicating lights, alarm contacts, test equipment, and programming devices. The Breaker Interface Module can monitor up to 50 devices which includes circuit breakers equipped with Digitrip OPTIM or Digitrip RMS 810/910 Trip Units, IQ Energy Sentinels and Universal IQ Energy Sentinels. The number of devices being monitored, however, cannot exceed 50 total. Like the OPTIMizer Hand Held Programmer (I.B. 29C892), the Breaker Interface Module can be used to program and test OPTIM Trip Units.

The Breaker Interface Module will communicate to multiple trip units over a sub-network, as well as a personal computer on a main network. When communicating with trip units and energy devices, the Breaker Interface Module acts as the master device. When communications is from a computer through the Breaker Interface Module via a PONI, the computer assumes the role of the master device (Figure **2-7**).

A user friendly operations panel, which is normally accessible from the outside of an assembly door, provides a means for:

- Programming
- Monitoring
- Identifying Devices
- Testing
- Being Alerted to Alarm Conditions
- Receiving Operational Help

LEDs, display windows, pushbuttons, and a mimic time-current curve make up the front of the operator panel.

The Breaker Interface Module provides the operator with all the feature capabilities of the Hand Held Programmer except for the following:

- Setting device address
- Setting BAUD rate

Notice: *A direct breaker connection via an OPTIMizer Hand Held Programmer will override an INCOM connection. This will cause a no response alarm on the Breaker Interface Module and a master network.*

An operator can use the Breaker Interface Module to:

- **Configure OPTIM Trip Unit**
  - Select breaker addresses
  - Select frequency (50/60 Hz)
  - Set security passwords
  - Change time-current setpoints
  - Select protection options
  - Select alarm levels

- **Display Information**
  - Breaker description/status
  - Time-current setpoints
  - Metered values
  - Trip event information

- **Test OPTIM Trip Unit Performance**
  - Phase and ground
  - Trip or no trip

- **Energy Monitoring**
  - Set addresses for group energy monitoring
  - Group energy readings
  - Configure alarms on demand exceeded
  - Indicate alarms via output contacts

- **Local and Remote Indication**
  - Remote indication/alarming
  - Breaker status indication

- **IMPACC Communications with**
  - Digitrip OPTIM Trip Units
  - Digitrip RMS 810/910 Trip Units
  - IQ Energy Sentinels and Universal IQ Energy Sentinels
  - Up to 50 devices total

Notice: *For detailed information concerning the installation, operation and maintenance of the Breaker Interface Module, refer to the instruction book prepared specifically for the Breaker Interface Module (I.B. 29C893).*

2-5 COMMUNICATIONS

Digitrip OPTIM Trip Units and the Breaker Interface Module are IMPACC compatible devices. OPTIM 550 can be field upgraded with IMPACC. As such, they can be remotely monitored, controlled and even, where applicable, programmed. The IMPACC Communications Network called INCOM is a noise immune communications network that permits communications from either device to a master computer via a high frequency carrier signal over a shielded twisted pair of conductors.

All OPTIM programming, configuration, advance warning, diagnostic, monitoring, and control capabilities are master computer accessible using IMPACC Series III software. Series III software provides the ability to monitor and record power distribution system data as it is occurring. Other software packages are available.

Custom billing software provides the capabilities to determine energy usage data by individual departments or tenants in a facility. The same package can then submeter electric bills based on the collected data.

Waveform and harmonic display software is capable of performing waveform analysis of phase currents A, B and C, as well as neutral and ground. In addition, THD (total harmonic distortion) and individual harmonic contents can be displayed and analyzed.

For more detailed information on IMPACC Communications, refer to Section 3.

SECTION 3 - IMPACC COMMUNICATIONS

3-1 OVERVIEW

Cutler-Hammer's IMPACC network is a unique system that centralizes multiple monitoring, protection, and control devices in a building's electrical distribution system.

Some significant benefits of an IMPACC system are:
- Improved energy management
- Scheduled maintenance reduces costs
- Early warning alerts to potential problems
- Instantaneous troubleshooting information
- Increased personnel productivity

Additionally, IMPACC offers the following advantages:
- Centralized information from all IMPACC compatible devices
- Flexibility with other control systems
- Ease of installation
- Ease of expandability

From a central location, an operator uses a master control unit (computer or programmable controller) to monitor, control, and communicate with all devices on the distribution system. This includes monitoring and control of switchgear, motor control centers, and medium-voltage starters, in addition to obtaining information from individual trip units, digital meters, motor protective relays, and motor starters (Figure **3-1**).

As many as 1000 devices can be handled on IMPACC. Communication lines can be extended up to 7500 feet from the master control unit with up to five main runs. A shielded, twisted pair of wire is used to daisy-chain the devices together.

IMPACC can be installed in new facilities, existing Westinghouse gear, or another manufacturer's system retrofitted with Westinghouse IMPACC devices. IMPACC easily expands to accommodate requirements of growing distribution systems.

3-2 SOFTWARE PRODUCTS

3-2.1 DR. IMPACC

Dr. IMPACC is a network diagnostic tool for the Cutler-Hammer IMPACC communication network. It can be used to determine the INCOM network configuration and can assist with troubleshooting network problems. Dr. IMPACC allows you to search your IMPACC network to identify the devices on that network and the communication status of each device. Dr. IMPACC can locate devices on both main and sub-networks and then report back to you specific device information such as device type, device address, and software version of the device.

Dr. IMPACC software disks are included with the CONI card and MINT II to aid in system set up and diagnostics. It is also available as a separate software package.

3-2.2 IMPACC SERIES III

Series III is a Microsoft Windows based software program that provides complete monitoring and controlling functions from a centralized location (Figure **3-2**). Data can be stored to generate standard or customized reports, charts, or graphs. Series III can expand with the system as devices are added.

Features

- **Easily expandable system**
  Series III is available in three package sized, 20, 200, and 1000 devices. A system upgrade costs only the difference in price between the two packages.

- **Windows interoperability**
  There is no dedicated computer needed with IMPACC Series III. Series III will monitor and log events while other programs are running in Windows. Alarms can be graphical and/or audible for signaling problems. Windows DDE is also supported, which allows data sharing with other Windows based programs.

- **Real time display from all IMPACC compatible devices**
  Metering, power, energy, device status, and more is displayed in a spreadsheet format for quick access to information.

- **System and device alarming**
  Warnings are provided by Series III upon changes in device status (open/close) along with troubleshooting information. Also, independent analog alarms can be set by the user. Series III will alert the user when a device has exceeded a preset threshold.

- **Time/event data logging**
  The time and cause of each event are logged directly to the computer and/or printer.

- **Trending functions**
  IMPACC Series III will trend metered data according

Mod Bus Gateway/
Ethernet Bridge to other
Distribution Control
System, Building
Management System,
PLCs, or PC software

OR

Personal Computer
with CONI and
Software with optional
Mod Bus/Ethernet/
MINT II Gateway
capability

OR

MINT II to other Distribution
Control Systems, Building
Management Systems, or
PLCs

OR

Westinghouse
Programmable
Logic Controller

Low Voltage Switchgear Type DSII

Digitrip OPTIM
Digitrip RMS
Assemblies Electronic Monitor II
IQ Analyzer
DP-4000
IQ Data/IQ Generator
Addressable Relay II

Low Voltage Switchboards

Digitrip OPTIM
Digitrip RMS
Assemblies Electronic Monitor II
IQ Analyzer
DP-4000
IQ Data/IQ Generator
Addressable Relay II
IQ Central Energy Display

Medium Voltage Amgard Starters

IQ 1000 II
IQ 500
DP-4000
IQ Data/IQ Generator
Universal RTD
Addressable Relay II

Medium Voltage VacClad-W Switchgear

Digitrip MV
IQ Analyzer
DP-4000
IQ Data/IQ Generator
IQ 1000 II
Universal RTD
Addressable Relay II

Panelboards

IQ Energy Sentinel
IQ Analyzer
DP-4000
IQ Data/IQ Generator
IQ Central Energy Display

Transfer Switches

IQ Transfer
Digitrip OPTIM
Digitrip RMS
IQ Analyzer
DP-4000
IQ Data/IQ Generator
Universal RTD
Addressable Relay II

Motor Control Center

ADVANTAGE
IQ Analyzer
DP-4000
IQ Data/IQ Generator
IQ Energy Sentinel
IQ 500
IQ 1000 II
Universal RTD
Addressable Relay II
Digitrip RMS
Assemblies Electronic Monitor II
Central Monitoring Unit
IQ Central Energy Display

Medium Voltage WLI Switchgear

IQ Analyzer
DP-4000
IQ Data/IQ Generator
Universal RTD
Addressable Relay II

Enclosed Control

ADVANTAGE
IQ Energy Sentinel
IQ 500
Addressable Relay II
Central Monitoring Unit
IQ Central Energy Display

Adjustable Frequency Drives

Accutrol Drive Controller
Addressable Relay II

Figure 3-1 Typical IMPACC Network Possibilities

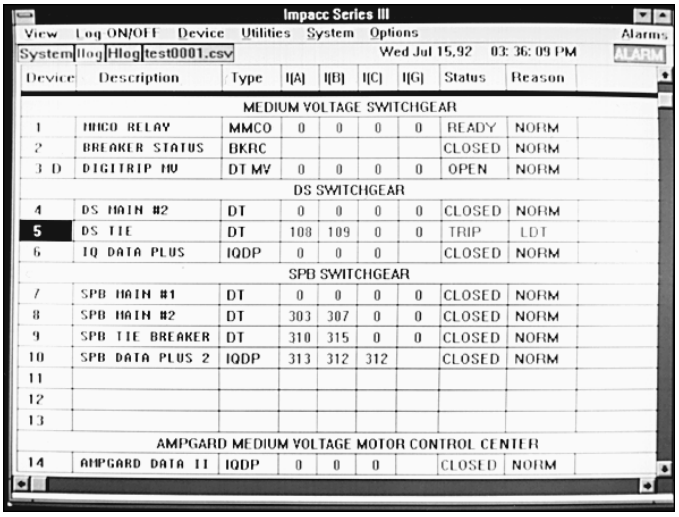

Figure 3-2 IMPACC Series III

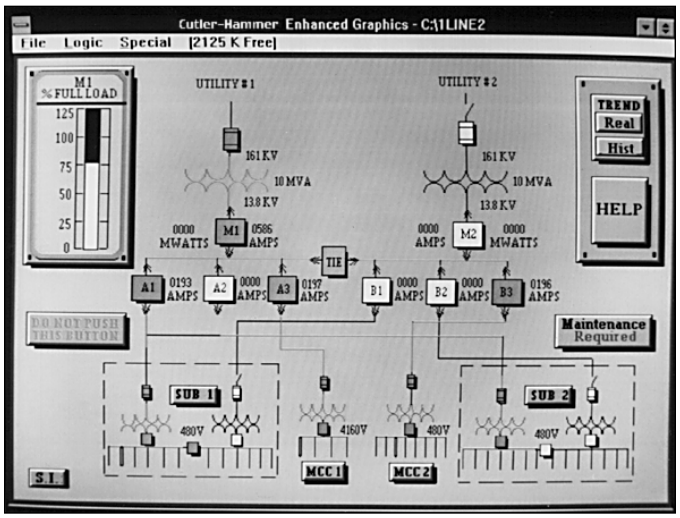

Figure 3-3 Enhanced Graphics

to a user selected period of time (5 min., 10 min., etc.). The data is then stored on the hard drive in a .CSV format.

- **Security**

  Up to 32 discrete access codes can be assigned to personnel to provide several levels of system security.

- **Simple configuration**

  Series III provides windows for device configuration with lists of all the IMPACC compatible devices built in. Configuration is as simple as clicking on a few buttons.

- **Gateway interfaces**

  This provides for communication of information to other computer systems on an as requested basis. This information can be obtained through RS232 (MINT) emulation, Mod Bus protocol, or Ethernet protocol.

3-2.3 ENHANCED GRAPHICS

Enhanced graphics is an add-on software package to IMPACC Series III that not only supports a complete set of functions - trending, data logging, alarming, reporting, and networking - but it also offers powerful graphics (Figure **3-3**). One-line drawings, face plate graphics, and elevation views are just a small sample of the many screens that view real-time data on a remote computer or the running Series III. (Note: Remote viewing requires the use of a serial port or a local area network card such as Ethernet.)

Features

- **Real-time display**

  Real-time data can be displayed digitally or on a trend (chart). The user can select the data to be trended.

- **Animation based on-site condition**

  Different colors indicate whether a breaker is opened or closed, a line is energized or de-energized, and if a device is in alarm condition.

- **Historical logging**

  Logging is done in Enhanced Graphics based on a percentage change of a selected value (both set by the user).

- **Multiple display formats**

  Many different formats are used to display information including one line diagrams, elevation views, a site plan, and a main directory. It is very simple to move quickly among the various screens.

- **Quick alarm location**

  When an alarm occurs an alarm locator will pop up on the screen. Clicking on the locator will take the user to the one line diagram of the area where the alarm is occurring. The device in alarm condition will have different colored, flashing text.

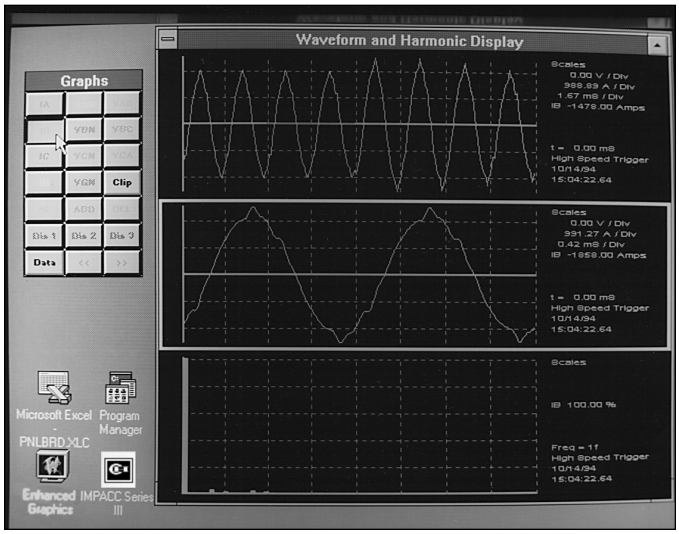

Figure 3-4 Waveform Display Software

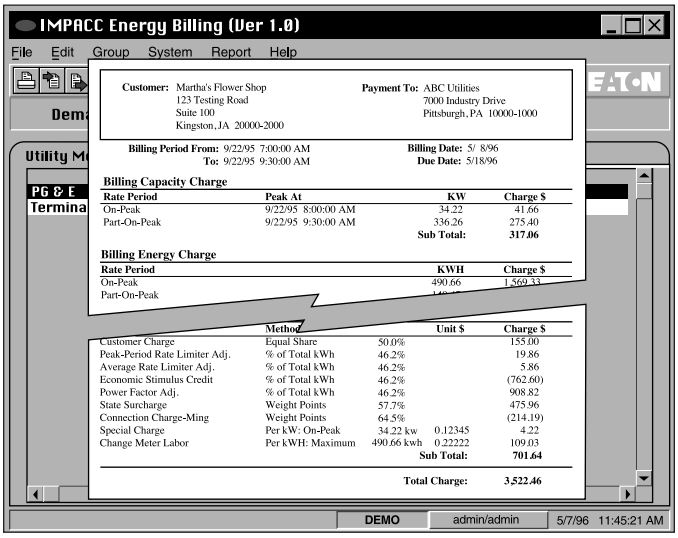

Figure 3-6 Energy Logging and Billing Display Software

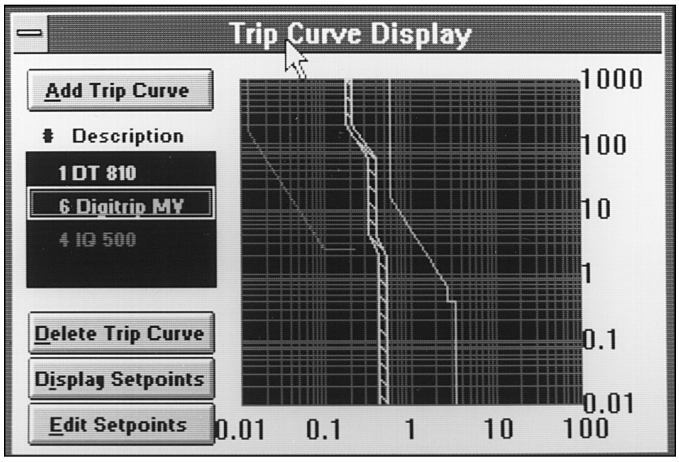

Figure 3-5 Trip Curve Display Software

3-2.4 WAVEFORM DISPLAY SOFTWARE

Waveform Display Software allows the display of captured waveforms from the IQ Analyzer, Digitrip 910, and Digitrip OPTIM 1050 (Figure **3-4**). It displays waveforms for phase to phase, phase to neutral, and neutral to ground voltages, and phase A, B, C, neutral, and ground currents. The waveforms can be displayed in three different ways:

- Eight cycles of the actual waveform
- Zoomed in view of two cycles of high speed sampled waveform
- Spectrum chart showing frequency content and magnitude (Fourier Analysis)

3-2.5 CIRCUIT BREAKER CONFIGURATION AND TRIP CURVE DISPLAY SOFTWARE

This software will display coordination curves based on actual breaker settings (Figure **3-5**). Also, the user can remotely configure breaker trip settings.

3-2.6 ENERGY LOGGING AND BILLING SOFTWARE

The software monitors power and energy parameters from IQ Energy Sentinels, DP-4000s, and Digitrip OPTIM Trip Units at a personal computer and generates electric “bills” based on those readings (Figure **3-6**). Information is saved in a database

Bills can be generated using the easy-to-use Cutler-Hammer Energy Logging and Billing Software. Where a high degree of customization is required, MS ACCESS or ORACLE can be used to create highly customized utility bills.

3-2.7 INTERFACING IMPACC

IMPACC can interface to PLCs and other DCS systems through the MINT II (refer to MINT II). The MINT II enables a personal computer or programmable logic controller with an RS232 port to function as the IMPACC system master control unit, and thus issue commands to and request data from IMPACC compatible devices.

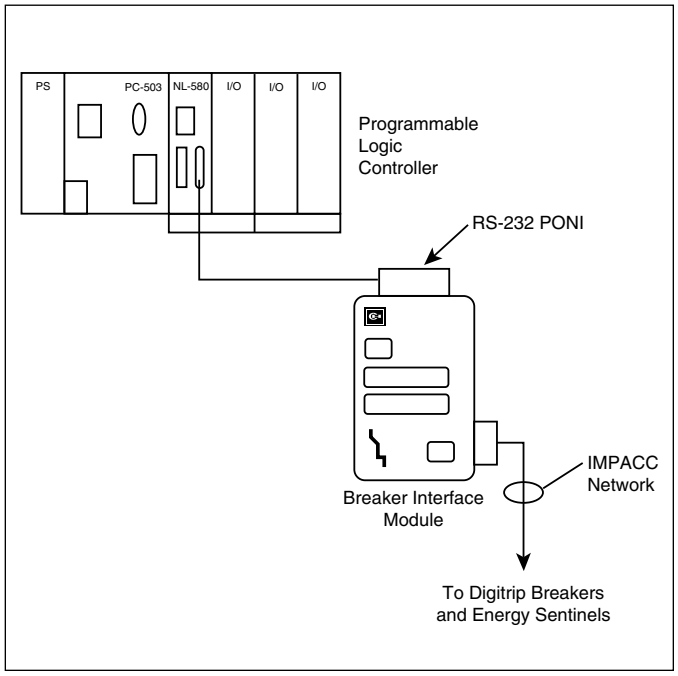

Figure 3-7 RS232 PONI

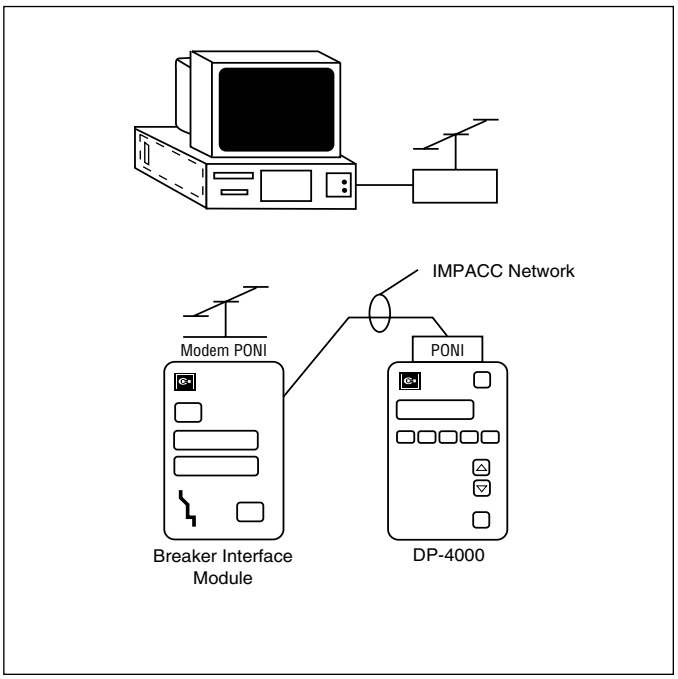

Figure 3-8 PONI Modem

Along with the MINT II, customers receive a Westinghouse IMPACC RS232 Interface Protocol Manual, which describes the structure of RS232 messages, how to issue commands, and how to receive data from IMPACC compatible devices. This enables users to write customized software that interfaces the MINT II and IMPACC compatible devices with their own control system. Additionally, it has the flexibility to run with existing RS232 systems.

3-3 COMMUNICATIONS HARDWARE

3-3.1 PRODUCT OPERATED NETWORK INTERFACE MODULE

The Product Operated Network Interface (PONI) module adds communications capability to various Cutler-Hammer products. The PONI module is easily mounted on the back of these devices, and requires no external power for operation.

RS232 Product Operated Network Interface Module

The RS232 Product Operated Network Interface (PONI) module is a point-to-point communication module (Figure **3-7**). The RS232 PONI allows any device with an RS232C port to monitor and control the Cutler-Hammer device. No external power is needed for operation.

Product Operated Network Interface Module Modem

The Product Operated Network Interface (PONI) modem is a point-to-point communication module that sends information from a solid-state control device through a single dedicated channel to a telephone modem (Figure **3-8**). No external power is required for operation.

3-3.2 COMPUTER OPERATED NETWORK INTERFACE CARD

The Computer Operated Network Interface (CONI) card communicates commands to and receives data from IMPACC compatible devices (Figure **3-9**). The CONI can be installed in an IBM PC or an approved IBM clone. The interrupts and baud rate for the CONI are selectable.

3-3.3 MASTER INCOM NETWORK TRANSLATOR II

The Master INCOM Network Translator (MINT II) enables any device with an RS232C port to function as an IMPACC network master, by converting the IMPACC signal to and from a 10 byte ASCII encoded hexadecimal RS232C message (Figure **3-10**). The MINT II has selectable IMPACC baud rates as well as selectable RS232 port baud rates.

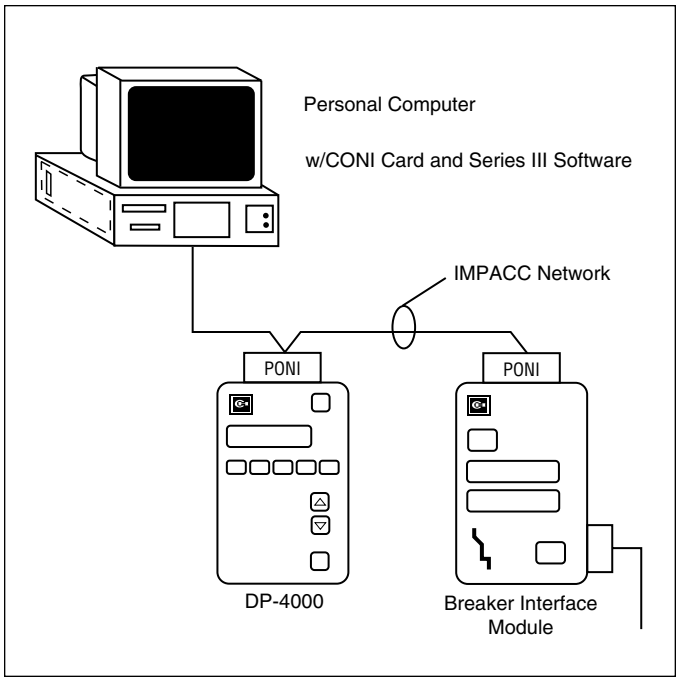

Figure 3-9 CONI Card

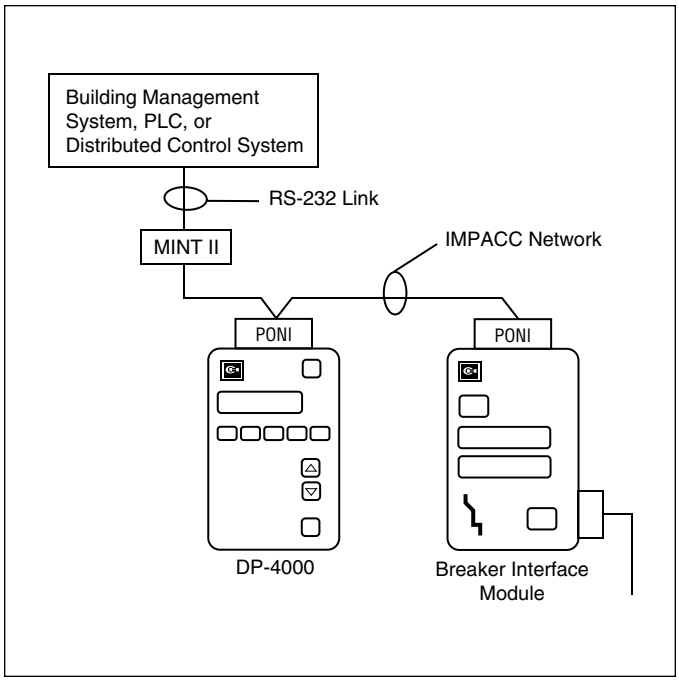

Figure 3-10 MINT II

3-3.4 PLC TO IMPACC INTERFACE MODULES

The PLC interface modules enable direct connection of the IMPACC network into a Westinghouse PLC (Figure **3-11**). This allows control and monitoring of any IMPACC compatible device from the PLC without adding additional hardware.

The NL-583 module can perform control and monitoring functions with ADVANTAGE starters or any other IMPACC compatible device.

For more information, see Programmable Logic Controllers.

3-3.5 MODBUS GATEWAY

The Modbus Gateway translates INCOM network communications into Modbus (Figure **3-12**). The Modbus Gateway uses a register mapping technique to place information from up to 200 IMPACC meters and protective relays into Modbus registers. The gateway also supports control features to allow the user (Modbus master) to send control commands to the IMPACC devices. An external 120 Vac power source is required for all gateways, bridges, and repeaters.

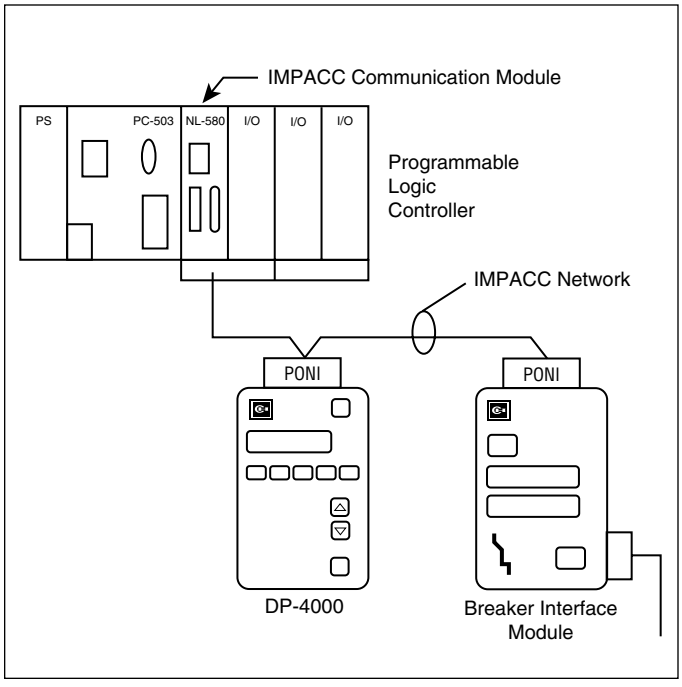

Figure 3-11 PLC Interface

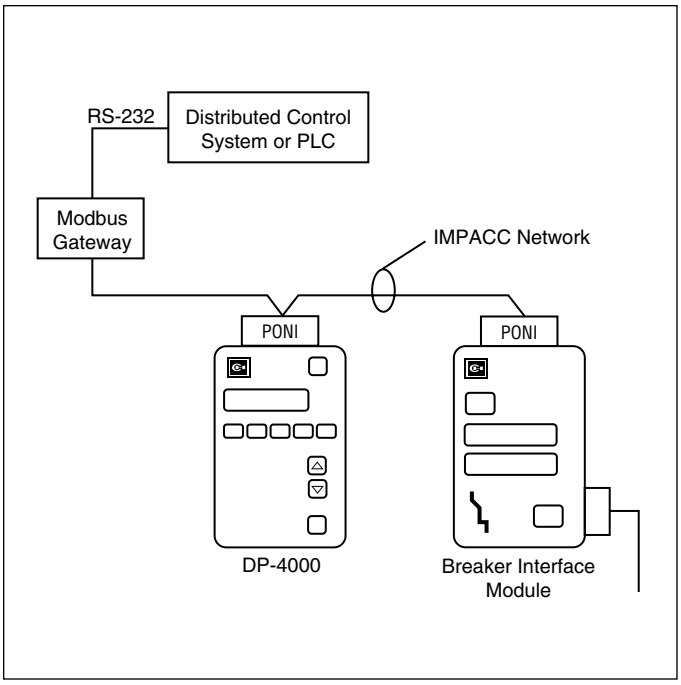

Figure 3-12 Modbus Gateway

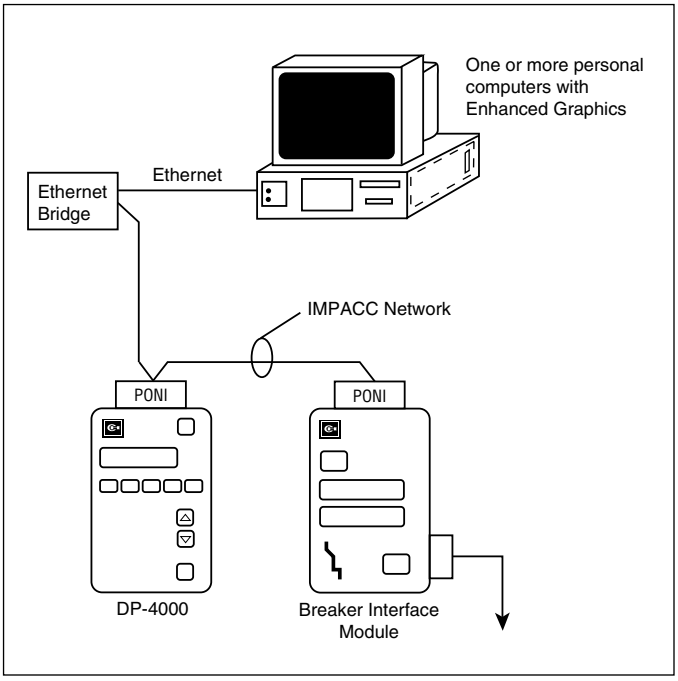

Figure 3-13 Ethernet Bridge

3-3.6 ETHERNET BRIDGE

The Ethernet Bridge translates INCOM network communications into Ethernet protocol (Figure **3-13**). The Ethernet Bridge provides the ability to bridge all IMPACC information onto a new existing Ethernet network, allowing the user to view information with Enhanced Graphics software or terminal emulation software packages. An external 120 Vac power source is required for all gateways, bridges, and repeaters.

3-4 NETWORK WIRING GUIDELINES

IMPACC (Integrated Monitoring Protection and Control Communications) was developed specifically for power distribution and industrial applications. It centers around the Industrial Communications (INCOM) communications network and has the following benefits:

- Devices are easily “daisy chained” with inexpensive shielded twisted pair cable
- Noise immunity and signal integrity verification ensure reliable data transfer
- Up to 1,000 devices are supported on a Main Network
- Up to 99 devices are supported in a Sub-network
- Up to 1,000 devices may be monitored and controlled from a single location running Series III software
- Distances of up to 10,000 feet are supported without repeaters
- Polarity is not an issue when connecting wiring to devices
- Wiring may be run as close to power wiring as NEC (or CSA) and local safety codes permit. Attention should be paid to NEC Articles 725, and 800 (NEC 1993) and CEC section 60 in particular rule 60-306 (CEC 1990)
- Wiring may be run in control and communication cable trays and conduit in accordance with NEC (or CSA) and local safety codes. Attention should be paid to NEC Articles 725, and 800 (NEC 1993) and CEC section 60 in particular rule 60-306 (CEC 1990)

System Configurations

The architecture for an IMPACC System allows all of the following (Figure **3-14**):

- Devices wired in a “daisy chained” fashion
- Devices wired in a “simple tap” fashion
- Devices organized as a “complex tap”
- Devices in a sub-network under a “submaster”

IMPACC (Integrated Monitoring Protection and Control Communications) was specifically designed with the intention of delivering a comprehensive and powerful energy management solution for use in electrical distribution environments while ensuring affordability, flexibility, simplicity and noise immunity. An IMPACC System installed per the rules presented in 3-4.1 through 3-4.5 will allow the user to fully realize all of the outlined advantages. Failure to follow these rules could result in sub-optimal system performance. These base rules are expected to have been followed as a starting point before troubleshooting is performed on a system.

The base rules apply for systems utilizing the Cutler-Hammer IPONI communication module on the main network. Use of non-INCOM based PONIs follow the rules of the communication physical layer for which they were designed (i.e. RS 232 PONI is point to point, 50 feet). Use of the Buffered PONI results in different system capacities. Please contact the Advanced Product Support Center for system's capacity information with this product.

3-4.1 CABLE SELECTION

Approved cable types:

- Any of the cables in the Belden 9463 family
- Quabbin 6205
- Commscope 9022
- IMPCABLE - a 600 V rated cable custom designed for IMPACC - Style # 2A95705G01

3-4.2 CABLE INTERMIXING

Any of the various application cables within the Belden 9463 family of cables may be intermixed without compromising communication performance.

Since industrial or commercial installations often require a wide range of cable application choices, preference should be given for wiring with Belden 9463. The Belden 9463 family of cables contains choices for armored, high temperature, direct burial, or plenum applications among others. For guidance in selecting the appropriate application cable from the Belden 9463 family of cables, or for technical information on IMPCABLE or Belden 9463 cables, contact Belden's Technical Support Desk by calling 1-800-235-3361 and selecting option 3.

Often one may choose to wire all Main Runs with Belden 9463 and wire Complex Taps or Sub-networks within distribution gear with IMPCABLE where a 600 volt rated cable may be required.

3-4.3 SYSTEM TOPOLOGY, SIZE, AND CAPACITY

Topology

- Bus or Single star
- Maximum of long lines from star: 5
- Line termination:
  - None for tap
  - 100 ohms at end of long line
- Maximum cable length between ends of longest lines: 10,000 feet

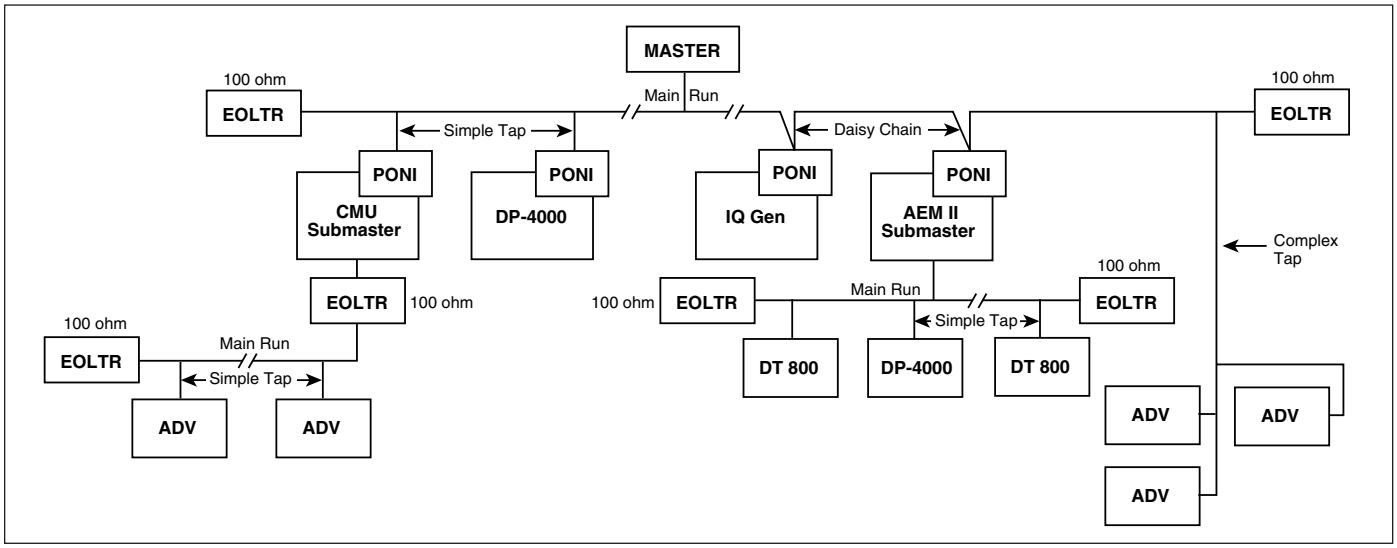

Figure 3-14 Architecture of Typical IMPACC System

Attenuation

- Total system capacity: 25 dB
- Attenuation per device: 0.01 dB
- Attenuation for approved wire types:

Cable type	Attenuation/1000feet
IMPCABLE	1.6 dB
Belden 9463 family	2.0 dB

- Attenuation at star:

Number of long lines	Attenuation
3	3.5 dB
4	6 dB
5	8 dB

Definition

- Daisy chain: point to point wiring between devices or clusters of devices
- Star: Single point with a number of long lines emanating from it
- Long line: >200 foot wire run
- Simple Tap: <200 foot connection to cluster of devices
- EOLTR: End of line terminating resistor

3-4.4 CABLE TERMINATION

The Main Runs of the Main Network and each sub-network require a pair of End Of Line Termination Resistors (EOLTRs) (Figure **3-15**). The EOLTRs maintain signal strength and minimize reflections. The EOLTRs should be 1/2 watt 100 ohm carbon or metal film resistors. Wire wound resistors are not acceptable. The EOLTRs should be placed at the two most distant points along the Main Runs of a Main Network or Sub-network.

3-4.5 DEVICE ADDRESS

In order to avoid the possibility of devices in a Main Network having the same addresses as those in Sub-networks, set Main Network device addresses at 100 or higher or excluding addresses 901 to 908. Devices in separate Sub-networks may have the same address settings.

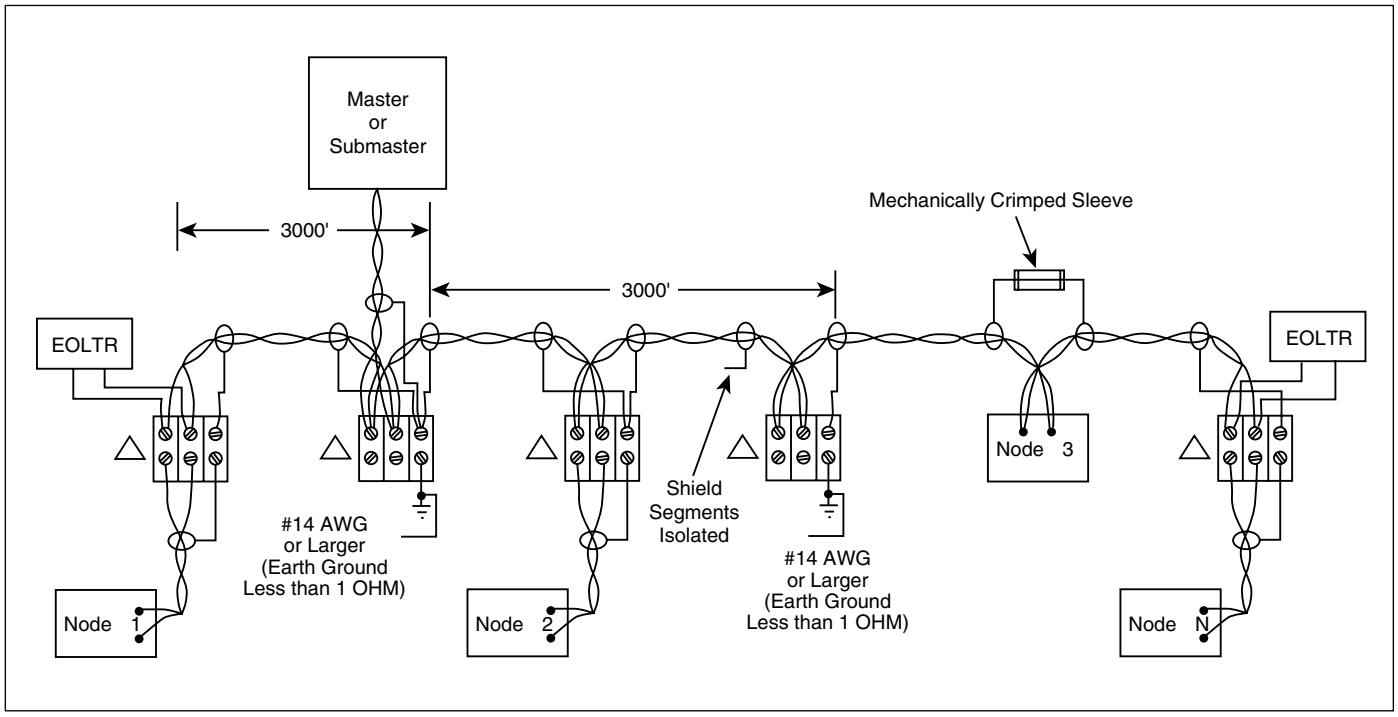

Figure 3-15 Typical End of Line Termination

APPENDIX A - INSTRUCTIONAL REFERENCES

A list of instructional references is provided in Table **A.1** to identify instructional documents that could be of assistance.

Table A.1 Instructional References (continued on next page)

DOCUMENT DESCRIPTION	DOCUMENT NUMBER
Circuit Breakers	
Series C̄ K-Frame Frame Book	IL 29-120K
Series C̄ L-Frame Frame Book	IL 29-120L
Series C̄ N-Frame Frame Book	IL 29-120N
Series C̄ R-Frame Frame Book	IL 29-120R
Series C̄ R-Frame Supplement	IL 29C713
SPB Systems Pow-R Breaker Supplement	IL 29849
DSII/DSLII Breaker Supplement	IL 8700C39
Digitrip OPTIM Trip Unit System	
OPTIM Trip Unit System Overview	IB 29C890
OPTIM Trip Units	IB 29C891
OPTIMizer Hand Held Programmer	IB 29C892
Breaker Interface Module	IB 29C893
Digitrip RMS Trip Units	
Digitrip RMS 810	IL 29-888
Digitrip RMS 910	IL 29-889
Digitrip OPTIM Wiring Diagrams	
Series C̄ K, L and N-Frame Wiring	IL 29C894
Series C̄ R-Frame Wiring	IL 29C714
SPB Systems Pow-R Wiring	IL 15545
DSII/DSLII Wiring	IL 1A33600
Energy Monitoring Devices	
IQ Energy Sentinel	
Series C̄ F-Frame	IL 17537
Series C̄ J-Frame	IL 17538
Series C̄ K-Frame	IL 17539
Universal IQ Energy Sentinel	
Internal	IL 17540
External	IL 17541
Communication Devices	
Communications Module (PONI)	
INCOM PONI	IL 17547
RS-232 PONI	IL 17202
Modem PONI	IL 17203
Buffered PONI	IL 17361
CONI	IL 17436
IMPACC Wiring Spec.	IL 17513

Table A.1 Instructional References (continued from previous page)

DOCUMENT DESCRIPTION	DOCUMENT NUMBER
Accessories	
Potential Transformer Module (K, L and N-Frame)	29C126
Ground Fault Indicator	1259C14G01
Digitrip OPTIM Time-Current Curves	
Series C̄ K-Frame Curves	
I^2t Long & Short Delay Phase	SC-6924-98
I^2t Long & Flat Short Delay Phase	SC-6925-98
I^4t Long & Flat Short Delay Phase	SC-6926-98
400A Instantaneous & Override Phase	SC-6927-98
250A Instantaneous & Override Phase	SC-6928-98
125A Instantaneous & Override Phase	SC-6929-98
Ground Fault Protection	SC-6930-98
Series C̄ L-Frame Curves	
I^2t Long & Short Delay Phase	SC-6323-96
I^2t Long & Flat Short Delay Phase	SC-6324-96
I^4t Long & Flat Short Delay Phase	SC-6325-96
600A Instantaneous & Override Phase	SC-6326-96
400A Instantaneous & Override Phase	SC-6327-96
Ground Fault Protection	SC-6330-96
Series C̄ N-Frame Curves	
I^2t Long & Short Delay Phase	SC-6331-96
I^2t Long & Flat Short Delay Phase	SC-6332-96
I^4t Long & Flat Short Delay Phase	SC-6333-96
Instantaneous & Override Phase	SC-6334-96
Ground Fault Protection	SC-6335-96
Series C̄ R-Frame Curves	
1600/2000A I^2t Long & Short Delay Phase	SC-6336-96
1600/2000A I^2t Long & Flat Short Delay Phase	SC-6337-96
1600/2000A I^4t Long & Flat Short Delay Phase	SC-6338-96
2500A I^2t Long & Short Delay Phase	SC-6339-96
2500A I^2t Long & Flat Short Delay Phase	SC-6340-96
2500A I^4t Long & Flat Short Delay Phase	SC-6341-96
1600A Instantaneous & Override Phase	SC-6342-96
2000A Instantaneous & Override Phase	SC-6343-96
2500A Instantaneous & Override Phase	SC-6344-96
1600A Ground Fault Protection	SC-6345-96
2000A Ground Fault Protection	SC-6346-96
2500A Ground Fault Protection	SC-6347-96
SPB Systems Pow-R Curves	
400-1200A I^2t Long & Short Delay Phase	SC-6348-96
400-1200A I^2t Long & Flat Short Delay Phase	SC-6349-96
400-1200A I^4t Long & Flat Short Delay Phase	SC-6350-96
1600-3000A I^2t Long & Short Delay Phase	SC-6351-96
1600-3000A I^2t Long & Flat Short Delay Phase	SC-6352-96
1600-3000A I^4t Long & Flat Short Delay Phase	SC-6353-96
4000-5000A I^2t Long & Short Delay Phase	SC-6354-96
4000-5000A I^2t Long & Flat Short Delay Phase	SC-6355-96
4000-5000A I^4t Long & Flat Short Delay Phase	SC-6356-96
400-1200A Instantaneous & Override Phase	SC-6357-96
1600-3000A Instantaneous & Override Phase	SC-6358-96
4000-5000A Instantaneous & Override Phase	SC-6359-96
Ground Fault Protection	SC-6360-96
DSII/DSLII Curves	
400-1200A I^2t Long & Short Delay Phase	SC-6275-95
400-1200A I^2t Long & Flat Short Delay Phase	SC-6276-95
400-1200A I^4t Long & Flat Short Delay Phase	SC-6277-95
1600-5000A I^2t Long & Short Delay Phase	SC-6278-95
1600-5000A I^2t Long & Flat Short Delay Phase	SC-6279-95
1600-5000A I^4t Long & Flat Short Delay Phase	SC-6280-95
400-1200A Instantaneous & Override Phase	SC-6281-96
1600-5000A Instantaneous & Override Phase	SC-6282-96
Ground Fault Protection	SC-6283-96

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